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ORIGINAL ARTICLE

Prevalence of the palmaris longus in relation to the hand dominance

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Abstract
Purpose The incidence of left-handedness in the general population is between 8 and 15%. There is a presumption that the prevalence of palmaris longus muscle differ between right-handed and left-handed people. This prospective study was conducted to determine the prevalence of the palmaris longus in relation to the hand dominance.
Methods The study included 542 subjects (216 male and 326 female). They were initially tested to hand dominance and after that they were asked to do the standard test (Schaeffer's test) for the assessment of the palmaris longus tendon. If the tendon was not visualized or palpable, four additional tests (Thompson's test, Mishra's tests I and II, Pushpakumar's "two-finger sign" method) were done to confirm its absence.
Results Right hand dominance was recorded in 452 (83.4%) subjects while the left hand dominance was recorded in 90 (16.6%) subjects. In right-handed subjects, palmaris longus tendon was absent on the right side in 24 (5.3%) and on the left side in 50 (11.1%) cases. In left-handed subjects, it was absent on the right side in 18 (20%) and on the left side in 2 (2.2%) cases. These differences were statistically significant. Bilateral absence of palmaris longus tendon was similar in both examined groups (25.1% in the overall series, 24.3% in right-handed subjects, 28.9% in left-handed subjects).
Conclusions The results of our study show that a right-sided absence was more common in left-handed persons while the left-sided absence was more common in right-handed persons. Unilateral tendon absence was more common on the non-dominant hand.

Keywords Palmaris longus muscle · Agenesis · Variations · Tendon graft · Hand dominance

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Introduction

Left hand dominance is less common than right hand dominance. About 8–15% of people are left-handed [7]. Some authors reported the prevalence of innate left-handedness of 9.4% in men and 7.4% in women [5].

The difference in grip strength between the dominant and non-dominant hand in left-handed individuals ranges from 0 to 5%, while in right-handed individuals the dominant hand is generally accepted to be 10% stronger than the non-dominant hand [13]. The non-dominant right hand of left-handed people is relatively stronger than the non-dominant left hand of right-handed people because most household appliances are intended for the right hand and accordingly, the right hand of everyone becomes stronger [3]. The presence or absence of the palmaris longus muscle had no effect on grip strength [20].

Palmaris longus muscle is often used in surgery because it is considered an accessory muscle and not essential for normal function of the hand [21]. The palmaris longus muscle is extremely variable both in number and form [27].

Some authors noted that the force of thumb abduction was greater on the hand with palmaris longus muscle than the hand without it [6]. These findings are in conflict with the current opinion that palmaris longus is a redundant

muscle whose major benefit is use as grafting or tendon transposition material.

Most standard textbooks of hand surgery report on the rate of palmaris longus muscle absence of 15% [9, 16, 22]. However, the rate of its absence varies across different populations around the world, from 0.6% in the Korean population through 63.9% in the Turkish population [1, 2]. As the result of this variation, studies of local populations are warranted. The presence or absence of palmaris longus muscle appears to have a strong genetic association [21]. Some authors report the incidence of agenesis to be higher in female subjects and on the left side [4, 15, 18].

In the literature, we did not find the data, although there is a presumption that the prevalence of palmaris longus muscle differ between right-handed and left-handed people. This prospective study was conducted to determine the prevalence of the palmaris longus in relation to the hand dominance.

Materials and methods

For the purpose of this study, 542 subjects (216 male and 326 female) were investigated. The presence of the palmaris longus was clinically determined in Caucasian men and women using the standard technique. Only subjects willing to participate in the study who have had untouched mobility of hand joints and wrist were included in study. Individuals with a history of injury, disease or abnormality of upper extremities that would preclude examination for the presence of the palmaris longus tendon were excluded from the study. The subjects' age ranged from 18 to 88 years, mean age 24.54 years.

First, study subjects were tested to hand dominance. After that they were asked to do the standard test (Schaeffer's test) for assessment of the palmaris longus tendon (Fig. 1). If the tendon was not visualized or palpable, four additional tests were done to confirm its absence. A single examiner checked all subjects. The following tests were used:

- Standard test (Schaeffer's test): the subject is asked to oppose the thumb to the little finger and then flex the wrist [17];
- Thompson's test: the subject is asked to make a fist, then flex the wrist and finally the thumb is opposed and flexed over the fingers [24];
- Mishra's test I: the metacarpophalangeal joints of all fingers are passively hyperextended by the examiner and the subject is asked to actively flex the wrist [12];
- Mishra's test II: the subject is asked to abduct the thumb against resistance with the wrist in slight palmar flexion [12]; and

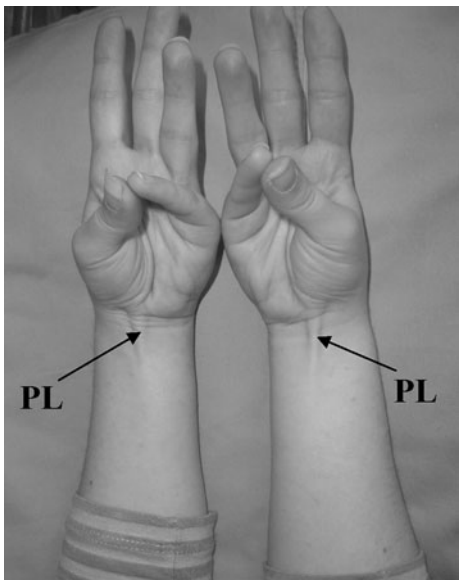

Fig. 1 Schaeffer's (standard) test

- Pushpakumar's "two-finger sign" method: the subject is asked to fully extend the index and middle fingers, the wrist and other fingers are flexed, and finally the thumb is fully opposed and flexed [14].

Data analysis was carried out using χ^2-test and t test.

Results

After hand dominance testing, we noted that 452 (83.4%) subjects were right-handed while 90 (16.6%) persons were left-handed.

Palmaris longus tendon was absent on the right side in 42 (7.7%) and on the left side in 52 (9.6%) subjects. The difference was not statistically significant between the right and left side ($\chi^2 = 1.16$; $P > 0.05$). The overall absence of palmaris longus (unilateral and bilateral) was 42.4% ($n = 230$). The results are shown in Table 1.

In right-handed subjects, palmaris longus tendon was absent on the right side in 24 (5.3%) and on the left side in 50 (11.1%) cases; the difference was statistically significant ($\chi^2 = 9.95$; $P < 0.05$). Bilateral absence of palmaris

Table 1 Palmaris longus absence in general population

Palmaris longus tendon	No. of examined individuals (%)
Bilateral present	312 (57.6)
Right absence	42 (7.7)
Left absence	52 (9.6)
Bilateral absence	136 (25.1)
Total	542 (100)

Table 2 Absence of palmaris longus tendon in two examined groups

Absence of palmaris longus tendon	Hand dominance	
	Right No. (%)	Left No. (%)
Bilateral present	268 (59.3)	44 (48.9)
Right absent	24 (5.3)	18 (20)
Left absent	50 (11.1)	2 (2.2)
Unilateral absent	74 (16.4)	20 (22.2)
Bilateral absent	110 (24.3)	26 (28.9)

longus tendon was recorded in 110 (24.3%) right-handed subjects. In left-handed subjects, it was absent on the right side in 18 (20%) and on the left side in 2 (2.2%) cases; the difference was statistically significant ($\chi^2 = 14.4$; $P < 0.05$). Bilateral absence of palmaris longus tendon was found in 26 (28.9%) left-handed subjects.

Hence, right-sided absence was more common in left-handed subjects than in right-handed, the difference was statistically significant ($\chi^2 = 22.66$; $P < 0.05$). Left-sided absence was more common in right-handed subjects than in left-handed, the difference being statistically significant ($\chi^2 = 6.76$; $P < 0.05$).

The difference in overall absence of the palmaris longus tendon (unilateral and bilateral) between right-handed and left-handed subjects was 10.4%. Hand dominance difference in the overall absence of the palmaris longus was not statistically significant.

The absence of palmaris longus tendon in the hand dominance groups is presented in Table 2. According to t test, there were no statistically significant differences among the two study groups ($t = 1.63$); however, the right-handed group showed a significantly lower rate of the palmaris longus presence on the left hand and vice versa.

Discussion

There are many papers about palmaris longus absence in different populations but in these works, the differences between right-handed and left-handed persons are not mentioned. Although, there is a presumption that the prevalence of palmaris longus muscle differ between right-handed and left-handed people.

The presence or absence of palmaris longus muscle appears to be hereditary but its genetic transmission is not clear [21]. Similarly, hand dominance is determined largely by genetics [11]. It has been suggested that palmaris longus is a phylogenetically degenerate metacarpophalangeal joint flexor [23]. This muscle, although of little functional use to the human upper limb, assumes great importance when used as a donor tendon for transfer or transplant [9].

In vertebrates, it is only found in mammals and is best developed in those where the forelimb is used for ambulation. For example, the palmaris longus is always present in the orangutan but is variably absent in higher apes such as chimpanzees and gorillas [8, 19, 25, 26].

Some authors noted that the force of thumb abduction was greater on the hand with palmaris longus muscle than the hand without it. Therefore, they recommend that this action of the muscle be universally accepted by anatomists and hand surgeons [6]. These findings are in conflict with the current opinion that palmaris longus is a redundant muscle whose major benefit is use as grafting or tendon transposition material. On the other hand, absence of the palmaris longus is not associated with a decrease of grip or pinch strength [20].

We tried to determine the average prevalence of palmaris longus absence in relation to the hand dominance. In the general population, the overall absence of the palmaris longus (unilateral and bilateral) was 42.4%. Unilateral absence of the palmaris longus muscle was recorded in 94 (17.3%) and bilateral absence in 136 (25.1%) subjects. Unilateral absence was significantly more common on the left side (9.6 vs. 7.7%). Our results are similar to the results of earlier studies [2, 4, 8, 10, 17] (Table 3).

Bilateral absence was slightly more common in left-handed subjects (28.9 vs. 24.3%). In right-handed subjects, the prevalence of palmaris longus absence on the right and left side was very different (5.3 vs. 11.1%), whereas left-handed persons showed a significant predominance of the

Table 3 Prevalence and distribution of palmaris longus agenesis in different studies—more common left side agenesis

Author	Palmaris longus			
	Bilateral present (%)	Right agenesis (%)	Left agenesis (%)	Bilateral agenesis (%)
Erić et al. (this study)	57.6	7.7	9.6	25.1
Erić et al. [4]	62.5	8.6	13	15.9
Sandeep et al. [17]	95.5	0.9	2.4	1.2
Kapoor et al. [8]	82.8	3	6.2	8
Kose et al. [10]	73.41	4.51	7.04	15.04
Ceyhan et al. [2]	33.1	8.4	12.2	43.2

right-sided palmaris longus absence (2.2% left-sided vs. 20% right-sided). Right-sided absence of the palmaris longus was more common in left-handed persons (20% left-handed vs. 5.3% right-handed), whereas left-sided absence of the palmaris longus was more common in right-handed (2.2% left-handed vs. 11.1% right-handed).

We are aware that these clinical studies may have some limitations like difficulty in assessment of all variations of PL muscle depending solely on physical examination. These variations although rarely seen may lead to misinterpretation of an existing muscle as absent. We can confirm these variations precisely using ultrasonography or MRI, but it is neither cost-effective nor time saving [10].

The results of our study show a relatively high incidence of tendon absence and pointed to more pronounced loss of the muscle on the left side in general population while the right-sided absence was more common in left-handed persons and vice versa. Unilateral tendon absence was more common on the non-dominant hand.

Conflict of interest The authors declare that they have no conflict of interest.

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